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P R E F A C E.

The object of this publication is—

- (1) To present an authentic map, showing the average annual distribution of rainfall throughout the Commonwealth.
- (2) To make known to existing and intending settlers what areas of country abound with quantities of rainfall suitable for the various agricultural enterprises.
- (3) To dispel many of the erroneous impressions that are current respecting the rainfall of Australia and Tasmania.

An attempt has been made to discuss briefly the rainfall from various stand-points, and also to describe from whence, and by what peculiar atmospheric agencies the rains are precipitated in different parts of the Continent.

It is proposed in the future to publish average rainfall charts, showing the monthly and seasonal creep and distribution of moisture, and also the extreme annual totals; and when the series is completed it will be followed by similar charts giving the annual and monthly distribution of temperature.

H. A. H.

March, 1908.

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RAINFALL MAP OF THE COMMONWEALTH OF AUSTRALIA.

This mean annual rainfall map of the Commonwealth of Australia has been compiled from observations taken during the decade ending 1906.

The ten-year period has been adopted to conform to the common scientific usage in compiling maps of this character, and also to enable an equitable comparison to be made with the records taken in inland districts of Western Australia, and in other parts of the interior, where the figures are only available for a period not longer than ten years.

It should be pointed out, however, that the period dealt with has been an unusually dry one, more especially over the northern and eastern parts of Australia, so that the averages presented on the chart in the earlier settled parts of the Continent at least are much below what may be considered an approximation to the true means.

The following tables show a comparison of the averages for all years with those deducted from the ten years records, also the difference between the two averages, the aggregates and percentages of shortages at a number of representative stations:—

Place.	Total No. Years.	Average for all Years.	Ten Years Average.	Difference.	Aggregate.	Percentage per annum above or below True mean.
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CAPITALS.

Brisbane	57	47.47	39.16	- 8.31	83.10	- 18
Sydney	67	48.80	44.28	- 4.52	45.20	- 9
Melbourne	63	26.35	25.50	- 0.85	8.50	- 3
Perth	31	33.03	32.54	- 0.49	4.90	- 1
Hobart	66	23.38	22.98	- 0.40	4.00	- 2
Adelaide	67	20.89	20.53	- 0.36	3.60	- 2

WESTERN AUSTRALIA.

Williams	22	21.44	20.14	- 1.30	13.00	- 6
Fortescue	19	10.04	8.85	- 1.19	11.90	- 12
Derby	21	27.25	26.09	- 1.16	11.60	- 4
Perth	31	33.03	32.59	- .49	4.90	- 1
Dongara	23	18.43	18.08	- .35	3.50	- 2
Berrigarra	19	8.00	7.66	- .34	3.40	- 4
Mt. Florence	20	14.85	14.58	- .27	2.70	- 2
Bunbury	30	36.56	36.49	- .07	.70	0
Hall's Creek	16	21.40	21.40	0	0	0
Carnamah	19	14.75	14.75	0	0	0
Cossack	25	11.66	14.65	+ 2.99	29.90	+ 26
Broome	17	23.35	24.80	+ 1.45	14.50	+ 6
Carnarvon	24	8.81	10.21	+ 1.40	14.00	+ 16
Mardie	19	7.09	8.19	+ 1.10	11.00	+ 16
Geraldton	29	17.35	18.29	+ .94	9.40	+ 5
Onslow	21	8.10	8.88	+ .78	7.80	+ 10
Williambury	18	8.61	9.36	+ .75	7.50	+ 9
Mangowine	19	11.18	11.93	+ .75	7.50	+ 7
Eyre	22	10.91	11.55	+ .64	6.40	+ 6
Southern Cross	17	9.06	9.59	+ .53	5.30	+ 6
Esperance	23	25.01	25.34	+ .33	3.30	+ 1
Wyndham	20	28.21	28.54	+ .33	3.30	+ 1
Balladonia	16	9.66	9.92	+ .26	2.60	+ 3
Murgoo	18	7.17	7.35	+ .18	1.80	+ 3
York	30	17.05	17.08	+ .03	.30	—

Place.	Total No. Years.	Average for all Years.	Ten Years Average.	Difference.	Aggregate.	Percentage per annum above or below True Mean.
Port Darwin	37	61.59	57.04	-4.55	45.50	-7
Daly Waters	34	27.16	24.08	-3.08	30.80	-11
Alice Springs	33	10.80	9.21	-1.59	15.90	-15
Charlotte Waters	33	5.38	3.80	-1.58	15.80	-29
Port Augusta	47	9.14	8.27	-0.87	8.70	-10
Cape Borda	38	24.76	24.34	-0.42	4.20	-2
Adelaide	67	20.89	20.53	-0.36	3.60	-2

SOUTH AUSTRALIA.

Cooktown	29	68.96	49.91	-19.05	190.50	-28
Geraldton	21	145.27	135.81	-9.46	94.60	-7
Brisbane	57	47.47	39.16	-8.31	83.10	-18
Mackay	36	69.42	61.73	-7.69	76.90	-11
Maryborough	36	46.58	39.49	-7.09	70.90	-15
Goondiwindi	28	29.27	22.99	-6.28	62.80	-21
Tambo	21	22.87	18.08	-4.79	47.90	-21
Bowen	36	40.40	35.62	-4.78	47.80	-12
Blackall	27	22.59	17.92	-4.67	46.70	-21
Charleville	34	19.71	15.30	-4.41	44.10	-22
Hughenden	22	19.12	14.92	-4.20	42.00	-22
Thursday Island	16	68.11	63.99	-4.12	41.20	-6
Springure	30	26.25	22.54	-3.71	37.10	-14
Boulia	21	11.45	8.72	-2.73	27.30	-24
Thargomindah	25	12.53	10.03	-2.50	25.00	-20
Cloncurry	23	19.35	17.02	-2.33	23.30	-12
Normanton	35	37.11	35.26	-1.85	18.50	-5

QUEENSLAND.

NEW SOUTH WALES.

Kempsey	37	48.65	38.70	-9.95	99.50	-20
Katoomba	22	57.72	49.43	-8.29	82.90	-15
Kurrajong	41	50.48	42.42	-8.06	80.60	-16
Kiama	22	52.26	45.15	-7.11	71.10	-14
Orange	37	36.71	29.93	-6.78	67.80	-18
Lismore	28	53.69	47.12	-6.57	65.70	-12
Parramatta	45	36.67	30.62	-6.05	60.50	-18
Young	36	25.76	20.50	-5.26	52.60	-20
Grenfell	22	25.34	20.29	-5.05	50.50	-20
Eden	38	34.45	29.53	-4.92	49.20	-14
Newcastle	45	47.33	42.43	-4.90	49.00	-10
Maitland	39	33.79	28.91	-4.88	48.80	-14
Moruya	32	36.31	31.55	-4.76	47.60	-13
Coonabarabran	27	29.57	24.85	-4.72	47.20	-16
Sydney	67	48.80	44.28	-4.52	45.20	-9
Mungindi	19	20.45	15.98	-4.47	44.70	-22
Gilgandra	24	25.21	21.11	-4.10	41.00	-16
Molong	23	29.42	25.53	-3.89	38.90	-13
Bingara	29	30.53	26.67	-3.86	38.60	-13
Wanaaring	26	11.53	7.74	-3.79	37.90	-33
Armidale	49	31.85	28.24	-3.61	36.10	-11
Cobar	26	14.81	11.20	-3.61	36.10	-24
Coolamon	21	20.98	17.39	-3.59	35.90	-17
Wagga	36	21.87	18.52	-3.35	33.50	-15
Condoblin	26	17.82	14.60	-3.22	32.20	-18
Bourke	36	15.29	12.20	-3.09	30.90	-20
Narrandera	27	17.45	14.36	-3.09	30.90	-18
Goulburn	49	25.83	22.76	-3.07	30.70	-12
Bathurst	49	23.95	20.95	-3.00	30.00	-12



METEOROLOGY OF AUSTRALIA.

COMMONWEALTH BUREAU OF METEOROLOGY,
MELBOURNE.

RAINFALL MAP
OF THE
COMMONWEALTH OF AUSTRALIA.

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Place	Total No. Years.	Average for all Years.	Ten Years Average.	Difference.	Aggregate.	Percentage per annum above or below True Mean.
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NEW SOUTH WALES—continued.

Hillston	27	14.28	11.60	-2.68	26.80	-19
Mudgee	37	26.26	23.62	-2.64	26.40	-10
Dubbo	37	22.42	19.80	-2.62	26.20	-12
Wilcannia	33	10.46	7.89	-2.57	25.70	-25
Forbes	32	20.28	17.78	-2.50	25.00	-12
Pilliga	24	20.10	17.86	-2.24	22.40	-11
Milparinka	24	7.99	5.76	-2.23	22.30	-28
Walgett	28	18.88	16.71	-2.17	21.70	-11
Moulamein	19	14.60	12.46	-2.14	21.40	-15
Deniliquin	48	16.58	14.79	-1.79	17.90	-11
Menindie	33	9.15	7.53	-1.62	16.20	-18
Hay	29	14.50	13.08	-1.42	14.20	-10
Broken Hill	20	9.25	8.08	-1.17	11.70	-13
Wentworth	39	11.84	10.69	-1.15	11.50	-10
Jervis Bay	40	58.67	58.00	-0.67	6.70	-1
Kiandra	41	65.09	68.46	+3.37	33.70	+5

VICTORIA.

Outtrim	24	45.69	40.59	-5.10	51.00	-11
Walwa	22	30.76	27.34	-3.42	34.20	-11
Cann River	13	39.86	36.63	-3.23	32.30	-8
Bonang	17	39.88	37.06	-2.82	28.20	-7
Brim	20	13.67	11.25	-2.42	24.20	-18
Castlemaine	28	23.86	21.45	-2.41	24.10	-10
Panmure	17	34.90	32.56	-2.34	23.40	-7
Jamieson	18	43.75	41.46	-2.29	22.90	-5
Penshurst	24	27.28	25.04	-2.24	22.40	-8
Tyrrell Downs	22	13.14	11.13	-2.01	20.10	-15
Katandra	22	18.91	16.92	-1.99	19.90	-11
Yarrawonga	27	19.98	18.01	-1.97	19.70	-10
Ensay	15	28.20	26.40	-1.80	18.00	-6
Glenorchy	20	21.12	19.44	-1.68	16.80	-8
Wilson's Promontory	34	42.45	40.77	-1.68	16.80	-4
Alexandra	28	27.15	25.51	-1.64	16.40	-6
Wodonga	16	26.83	25.22	-1.61	16.10	-6
Dartmoor	22	31.82	30.29	-1.53	15.30	-5
Serviceton	11	19.50	18.00	-1.50	15.00	-8
Echuca	28	17.05	15.60	-1.45	14.50	-9
Charlton	24	16.44	15.02	-1.42	14.20	-9
Koondrook	19	14.52	13.18	-1.34	13.40	-9
Kardella	20	48.57	47.28	-1.29	12.90	-3
Swan Hill	22	13.43	12.17	-1.26	12.60	-9
Bright	25	41.24	39.99	-1.25	12.50	-3
Cape Otway	43	34.15	32.91	-1.24	12.40	-4
Murtoa	23	16.15	14.96	-1.19	11.90	-7
Warrnambool	30	25.03	23.88	-1.15	11.50	-5
Bendigo	45	21.54	20.43	-1.11	11.10	-5
St. Arnaud	26	19.35	18.24	-1.11	11.10	-6
Great Western	14	21.06	20.11	-0.95	9.50	-5
Harrow	22	22.29	21.37	-0.92	9.20	-4
Karnak	16	19.97	19.10	-0.87	8.70	-4
Melbourne	63	26.35	25.50	-0.85	8.50	-3
Avoca	22	20.82	20.02	-0.80	8.00	-4
Portland	45	32.87	32.07	-0.80	8.00	-2
Mildura	16	11.01	10.23	-0.78	7.80	-7
Omeo	27	26.01	25.35	-0.66	6.60	-3
Mortlake	25	26.65	26.13	-0.52	5.20	-2

Place.	Total No. Years.	Average for all Years.	Ten Years Average.	Difference.	Aggregate.	Percentage per annum above or below True Mean.
VICTORIA—continued.						
Ballarat ...	25	28.45	27.98	-0.47	4.70	-2
Warracknabeal ...	33	14.68	14.30	-0.38	3.80	-3
Casterton ...	20	25.60	25.26	-0.34	3.40	-1
Colac ...	15	30.64	30.43	-0.21	2.10	-1
Warragul ...	18	39.76	39.67	-0.09	0.90	0
Cape Schanck ...	27	29.95	29.91	-0.04	0.40	0
Horsham ...	33	17.30	17.44	+0.14	1.40	+1
Sale ...	15	23.74	23.90	+0.16	1.60	+1
Bairnsdale ...	27	29.01	29.22	+0.21	2.10	+1
Cobden ...	11	30.45	30.67	+0.22	2.20	+1
Dandenong ...	28	32.03	32.27	+0.24	2.40	+1
Buangor ...	28	22.93	23.24	+0.31	3.10	+1
Geelong ...	10	16.74	17.39	+0.65	6.50	+4
Lismore ...	30	20.95	21.61	+0.66	6.60	+3
Port Albert ...	39	25.48	26.58	+1.10	11.00	+4
Warburton ...	27	53.55	55.39	+1.84	18.40	+3
Buchan ...	23	34.06	34.38	+0.32	3.20	+1

TASMANIA.

Swansea ...	22	26.29	25.21	-4.08	40.80	-16
Gould's Country ...	21	48.60	46.99	-1.61	16.10	-4
Launceston ...	22	28.05	26.60	-1.45	14.50	-5
Mount Nelson ...	22	25.04	23.89	-1.15	11.50	-5
Low Head ...	25	26.37	25.68	- .69	6.90	-3
Boobyalla ...	18	26.11	26.00	- .11	1.10	0
Waratah ...	23	84.44	92.30	+7.86	78.60	+9
Burnie ...	22	38.48	40.96	+2.48	24.80	+6
Stanley ...	25	33.17	34.24	+1.07	10.70	+3
South Bruni ...	17	40.15	40.54	+ .39	3.90	+1
Oaklands ...	21	21.40	21.69	+ .29	2.90	+1
Hobart ...	66	23.38	23.53	+ .15	1.50	+1

At Cooktown, in Northern Queensland, it will be observed the total shortage for the ten years amounted to over 190 inches, or an annual drop of 28 per cent. At other coastal stations the falling-off was very much less, but at inland stations the annual shrinkage was generally over 20 per cent., and for the State as a whole 16 per cent. per annum.

In New South Wales the greatest falling-off occurred in the North-Western and Northern districts. At Wanaaring it amounted to 33 per cent., and at many other places on and east of the mountains to considerably over 20 per cent. per annum.

Kempsey had an aggregate shortage of 99.50 inches for the decade, Katoomba 83 inches, Kurrajong 81 inches, Lismore 66 inches, Newcastle and Maitland 49 inches each, and Sydney over 45 inches.

A contemplation of these figures is a matter of serious import, both to the primary producers and to the residents of largely-populated centres dependent upon water conservation for domestic purposes, more especially in regard to the health of the community. The knowledge that the experience of the last ten years may be again repeated emphasizes the imperative necessity of conserving to the fullest extent the abundant rain of good seasons. Privation, sickness, and loss of life have been endured in country districts during acute stages of the past drought, and unless steps are immediately taken to

meet the increased demands by reason of the increase of population, and the more extensive use of conservation waters for irrigation purposes, the loss and suffering to the population, more especially of inland settlements, will be accentuated when these droughty seasons recur. In the Northern and Central Territory the shortage amounted to 15 per cent. per annum, but in South Australia proper it was only about 5 per cent., and in Victoria only about 4 per cent., while in Tasmania it deviated from the mean to even a smaller amount. In Western Australia it was 3 per cent. per annum above the long period mean, which bears out the contention that good rains in the Western half of the Continent are generally synonymous with poor rains over the eastern half.

A casual glance at the map will show that the heaviest rains fall over the northern and eastern parts of the Continent, but while this is so, the most reliable, although lighter rains, are experienced over the south-western and south-eastern portions, including Tasmania.

The driest part of Australia, that which receives a rainfall of 10 inches and under, comprises an area equalling nearly one-third of the Commonwealth, and including the central Territory of South Australia, the extreme western parts of New South Wales, the south-western parts of Queensland, and the south-eastern, central, and part of the north-western portions of Western Australia. The limits of this dry area are shown by the 10-inch isohyetal line.

One million and eighty thousand (1,080,000) square miles of country, or over one-third of the Continent, receive an average of from 10 to 20 inches, and the remaining third enjoys abundant rains, ranging from 20 to 130 inches per annum. The wettest part of the Commonwealth is situated about the Johnston River, on the north-east coast of Queensland, and on the west coast of Tasmania. The highest annual average recorded is 130 inches at Geraldton, in the first-named State, and 114 inches at Queenstown, in the second-named State. Sixty inches and over are annually averaged on several portions of the Queensland and New South Wales coasts, and also on the Southern Alps, on the border of New South Wales and Victoria. The least rainfall average in the Commonwealth, 3.8 inches, occurs over a comparatively small area of country in the centre of the Continent to the north of Lake Eyre.

The main agents and disturbances producing the rainfall are, the south-east and westerly trade winds, the moosoonal and southern depressions, cyclones from the north-east and north-west tropics, locally-formed cyclones, and the anti-cyclones.

The south-east trades precipitate copious rains along the Pacific slopes N. of latitude 30 deg. S., and operate more particularly during the first three months of the year.

The westerly trade winds are mainly responsible for the rainfalls along the southern parts of the Continent and over Tasmania. The bulk of the falls take place during the winter and spring months of the year.

The rains in the interior are almost entirely derived from monsoonal depressions, which show most energy during the first three months of the year; but they are also in evidence at frequent intervals during the remaining nine months.

The three distinctive cyclones, *i.e.*, those from the north-east, and north-west, and locally-formed, are very erratic in their visitations,

which generally take place in the summer months, and those on the east coast occasionally in the winter and spring. Several have occurred in some years, while other years have passed without a single visitation. The good coastal rains of New South Wales are chiefly derived from the anti-cyclones when travelling in high latitudes across the ocean to the south of the Continent.

A remarkable feature of the map is the irregularity of the course followed by the isohyets, more particularly over eastern parts of New South Wales and Victoria, illustrating in a marked degree the effect of elevation upon precipitation. The first distinctive kink in the isohyets is that shown to the west of Brisbane, due to the western trend of the mountains in that latitude; the second kink is due to the increased elevation of the dividing range in the New England districts, some of the peaks rising to nearly 5,000 feet, and to the Warrumbungle range which runs westward to Coonabarabran. The following westerly trend of the rain curve is due to a mountain ridge to the north of the Hunter Valley; the next one is caused by the Blue Mountains and the Canoblas; and finally, the enclosed isohyets to the south of New South Wales and in Eastern Victoria, to the Australian Alps.

It will be noticed that a narrow strip of country in New South Wales, running north and south, between latitudes 34 deg. and 37 deg. S. has an average rainfall of 20 inches or less. Most of this country has an elevation of over 2,000 feet, but the rains are intercepted both to the east and west of it by ranges of a greater height, hence the shortage.

The good rains in south-western parts of Western Australia are due to the fact that this is the first land in Australia to intercept the fully charged moisture of the westerly trade winds. The same explanation applies to those of the west coast of Tasmania with the additional influence of the precipitous nature of the mountains there.

The southern parts of the Continent, where the precipitations are controlled by the southern depressions, enjoy very consistent annual totals, but north of the tropics, and in fact in all parts of the Continent subject to monsoonal rains, the departures from the normal are occasionally very great. A discussion of the rainfall statistics of the capitals will be sufficient to emphasize this fact. Brisbane, the most northern of our capitals, had as much as 88.26 inches in the year 1893, and as little as 16.17 inches in 1902, or a range of over 72 inches. In Sydney the range is 61 inches, the greatest total occurring in 1860, and the least in 1849. The disparities in the south are, as already indicated, much less, the range at Melbourne being 21 inches, and at Adelaide but 17.

When compared with other Continents the quantities and distribution of rainfalls over Australia are not so unfavorable as is generally supposed, and it will doubtless be a surprise to many to learn that quite one-third of North America has an annual rainfall of only 20 inches and under, while in parts of the Western States and California the average annual totals do not exceed 5 inches.

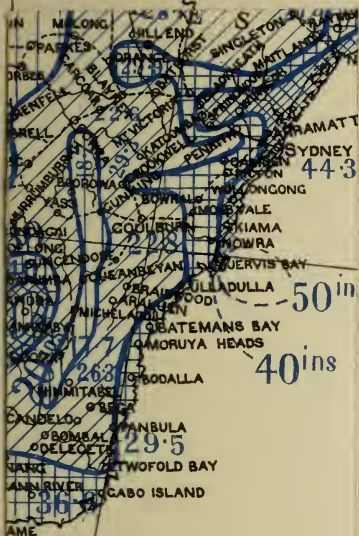
In Europe, too, the greater part of Russia, two-thirds of Sweden, and the eastern parts of Spain, comprising quite a third of the Continent, have an average of under 20 inches.

Comparing the rainfalls of the chief cities of the rest of the world with those of Australia, we find that Bombay, Calcutta, Colombo, Singapore, and Hong Kong are the only places out of a list of 42 that exceed the totals of Sydney and Brisbane. Perth has a greater annual rainfall than New York, and more than that of 28 other cities of the 42. Hobart nearly equals London, which Melbourne exceeds by an inch. Eleven of the 42 cities mentioned have less rain than Hobart.

It must not be forgotten, however, that in the northern half of Australia, in common with experience in all tropical countries, the seasons and rainfalls are more erratic than those of more temperate latitudes, and also that the element of evaporation seriously discounts the benefits of the abundant rains. To benefit to the fullest extent from the splendid rains that periodically visit Australia, and to tide us over the less generous seasons, it is imperative that the people, individually and collectively, should realize and insist upon the necessity of conserving the waters, more especially of the interior, and of protecting the same, as well as the land, from the effects of desiccating winds by the judicious planting of trees. As showing the enormous loss of water from tanks by evaporation, experiments made in various parts of Australia prove that as much as 3 to 6 feet in depth is lost over the coastal areas by this means, and from 6 to nearly 12 feet in the interior during the twelve months.

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COMMONWEALTH METEOROLOGY.

ISOHYETS

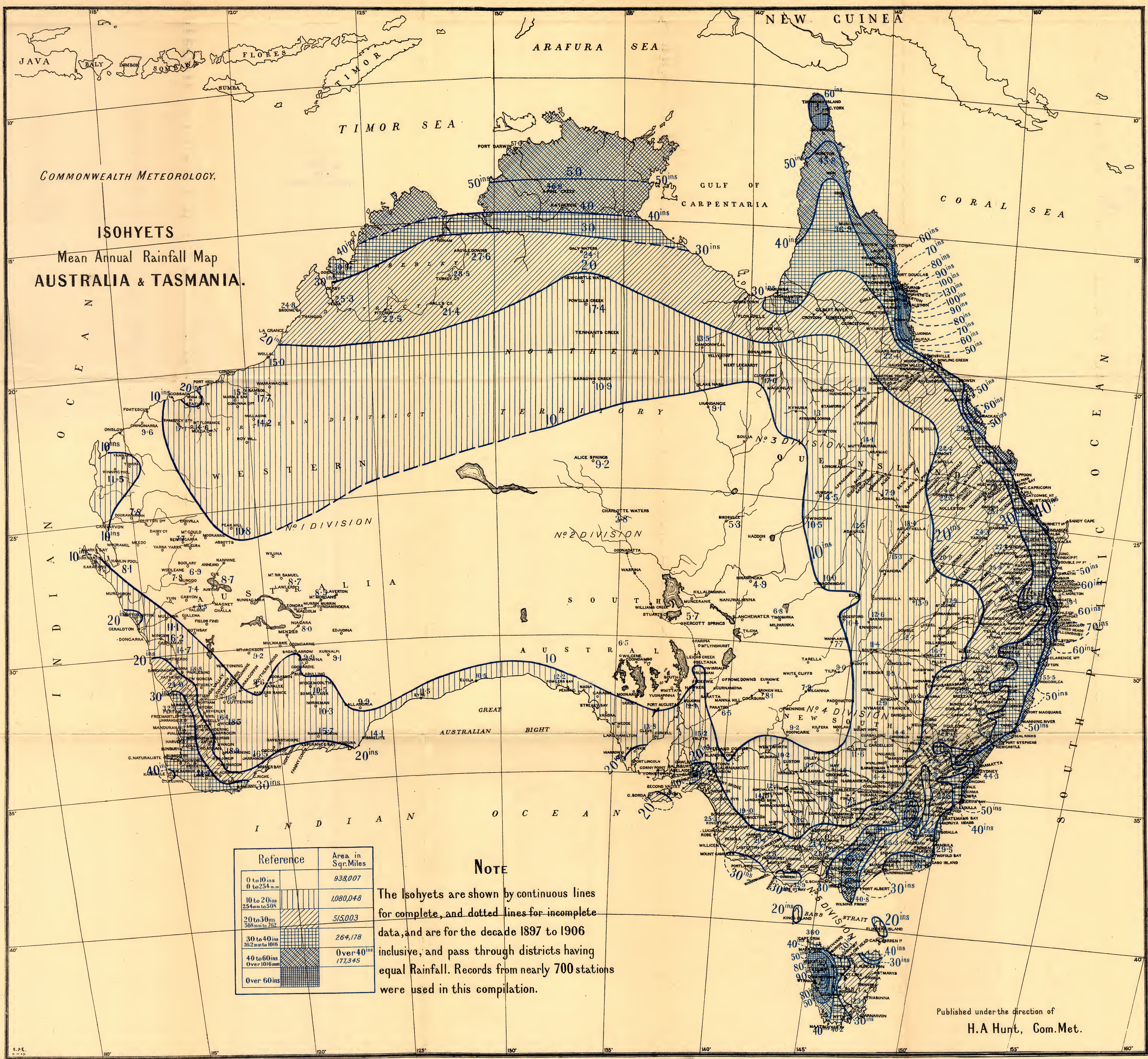
Mean Annual Rainfall Map

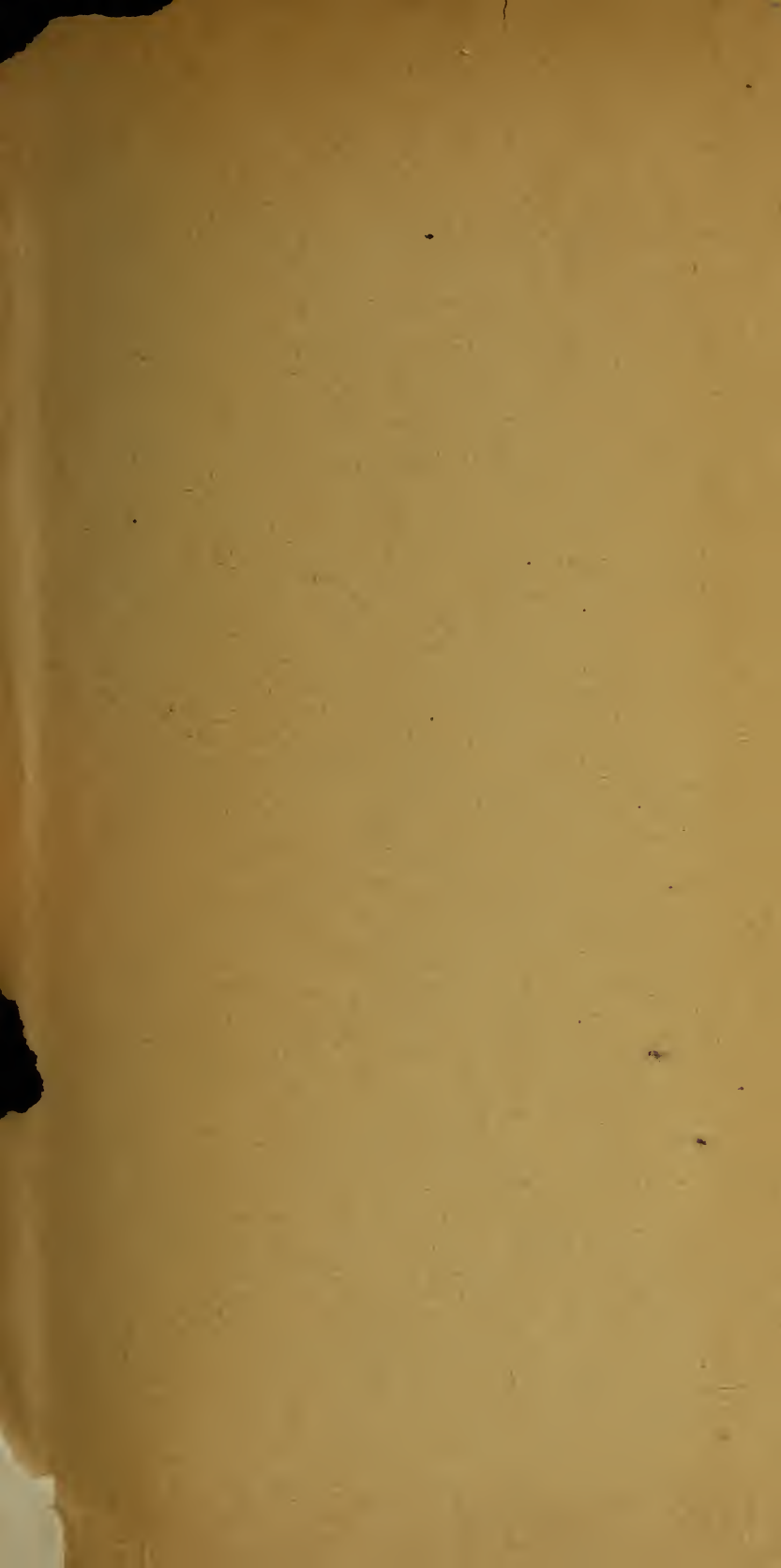
AUSTRALIA & TASMANIA.

Reference	Area in Sq. Miles
0 to 10 ins 0 to 254 m.m.	938,007
10 to 20 ins 254 m.m. to 508	1,080,048
20 to 30 ins 508 m.m. to 762	515,003
30 to 40 ins 762 m.m. to 1016	264,178
40 to 60 ins Over 1016 m.m.	Over 40 ins 177,345
Over 60 ins	

NOTE

The Isohyets are shown by continuous lines for complete, and dotted lines for incomplete data, and are for the decade 1897 to 1906 inclusive, and pass through districts having equal Rainfall. Records from nearly 700 stations were used in this compilation.







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